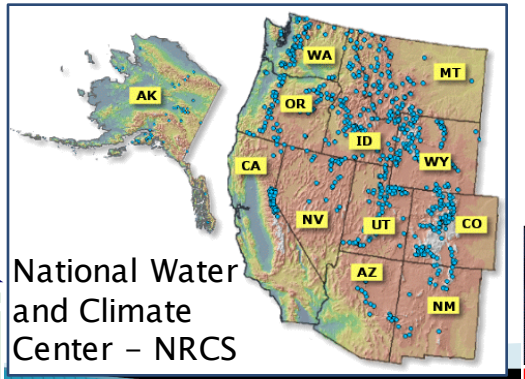
# Missouri River Basin
# Inter-Agency Proposal for an Expanded Plains Snow and Basin Conditions Network




National Water and Climate Center – NRCS

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Kevin Grode, US Army Corps of Engr
National Soil Moisture Network Workshop
Boulder, CO – May 2016

US Army Corps of Engineers®
Northwestern Division

# Why?


June 22, 2011 – just north of Omaha, NE, looking south

West Whitlocks Boat Ramp
Lake Oahe, SD (~2005)

**Current and relevant basin condition information is needed for all periods – flood … drought … and everything in between.**

# Proposal for a Missouri River Basin Interagency Expanded Plains Snow and Basin Condition Network

**Flood of 2011 – Independent Technical Review (ITR) – (Rec. #5):**

*Studies to enhance data collection, forecasting, and resulting runoff from plains snow. Suggested activities include establishment of additional permanent plains snow measurement stations (using already established snow measurement standards), focused on the development of improved historical record at permanent stations; and research on the effects of prairie soils, geomorphology, and hydrology on snowmelt runoff. Also, the Corps should work to improve collaboration with other groups that collect and analyze snow data*

March 2012:

"An expanded Plains snowpack monitoring system needs to be set up while memories of the floods are fresh and everyone is willing to spend the money, (SD Governor) **Daugaard** told top officials of the U.S. Army Corps of Engineers,"

"(USACE NWD Commander) **McMahon** said the corps is working with other agencies to determine how to create and fund an expanded plains snowpack monitoring system, one of the recommendations made by an expert panel that studied last summer's flooding. A more extensive system is already in place for monitoring the snowpack in the northern Rocky Mountains, he said."

# Timeline

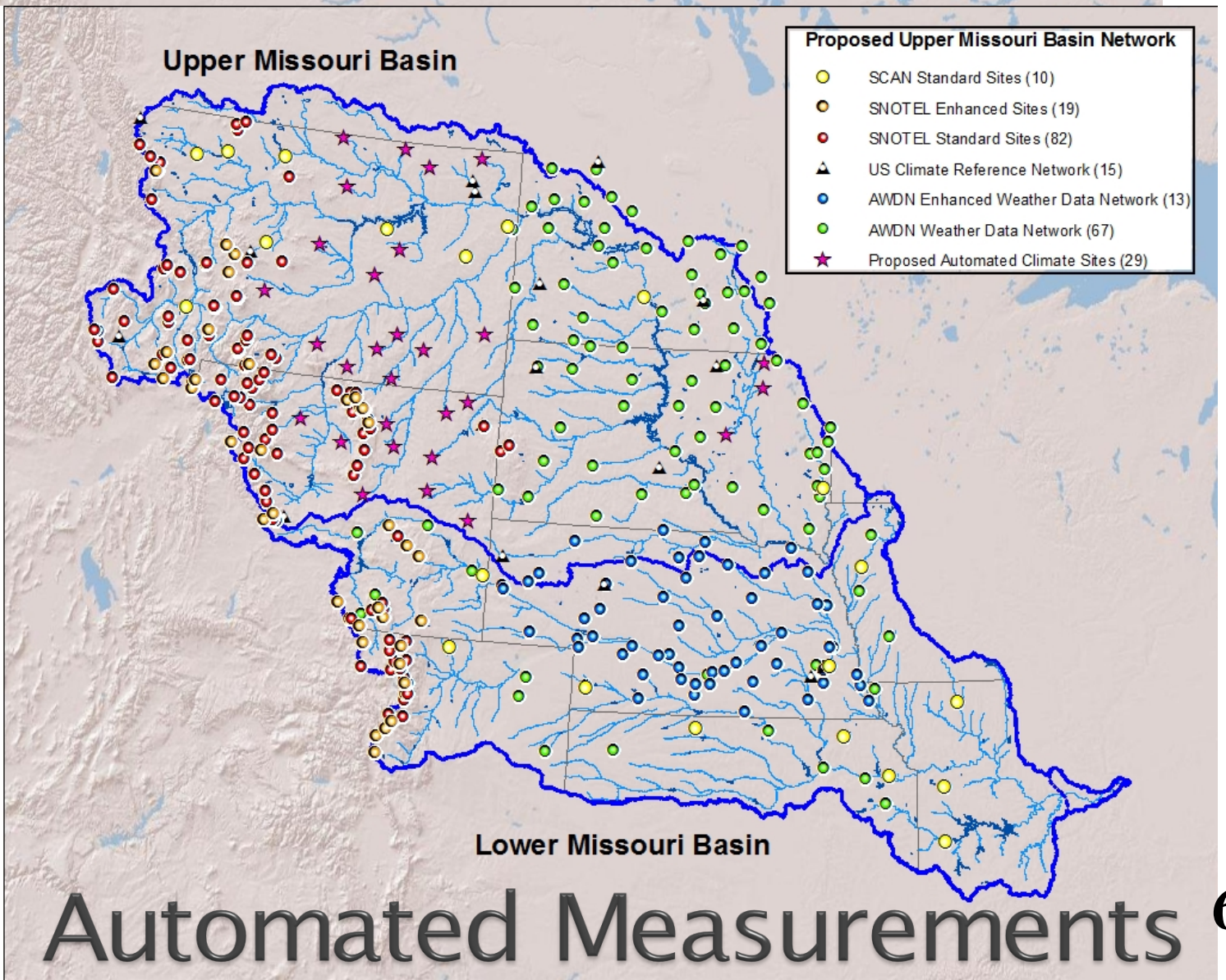
- Mar-Apr (2012) – Project Initialization/Team Formation
- Apr-Jul (2012) – Development of Initial Proposal/Framework
- In WRDA 2013 bill (Section 5008)
- WRRDA 2014 bill – passed June 2014, Section 4003
- WRRDA authorized, but did not fund
- GAO Report, June 2015 … not much progress made
- April 2016 – Senator Rounds (SD-R), EPW Subcommittee Mtg
- April 2016 – House Record 2028, Amend. 3844 to 3801
- $2M to establish basin condition network
- May 2016 – HR 2028, passed House (5/1) and Senate (5/12)
- Future … House re-vote, President signs …?

# Process, Process, Process …

- **Inventory** of existing federal, state and volunteer networks – climate, snowpack and soil moisture … leverage what is available.

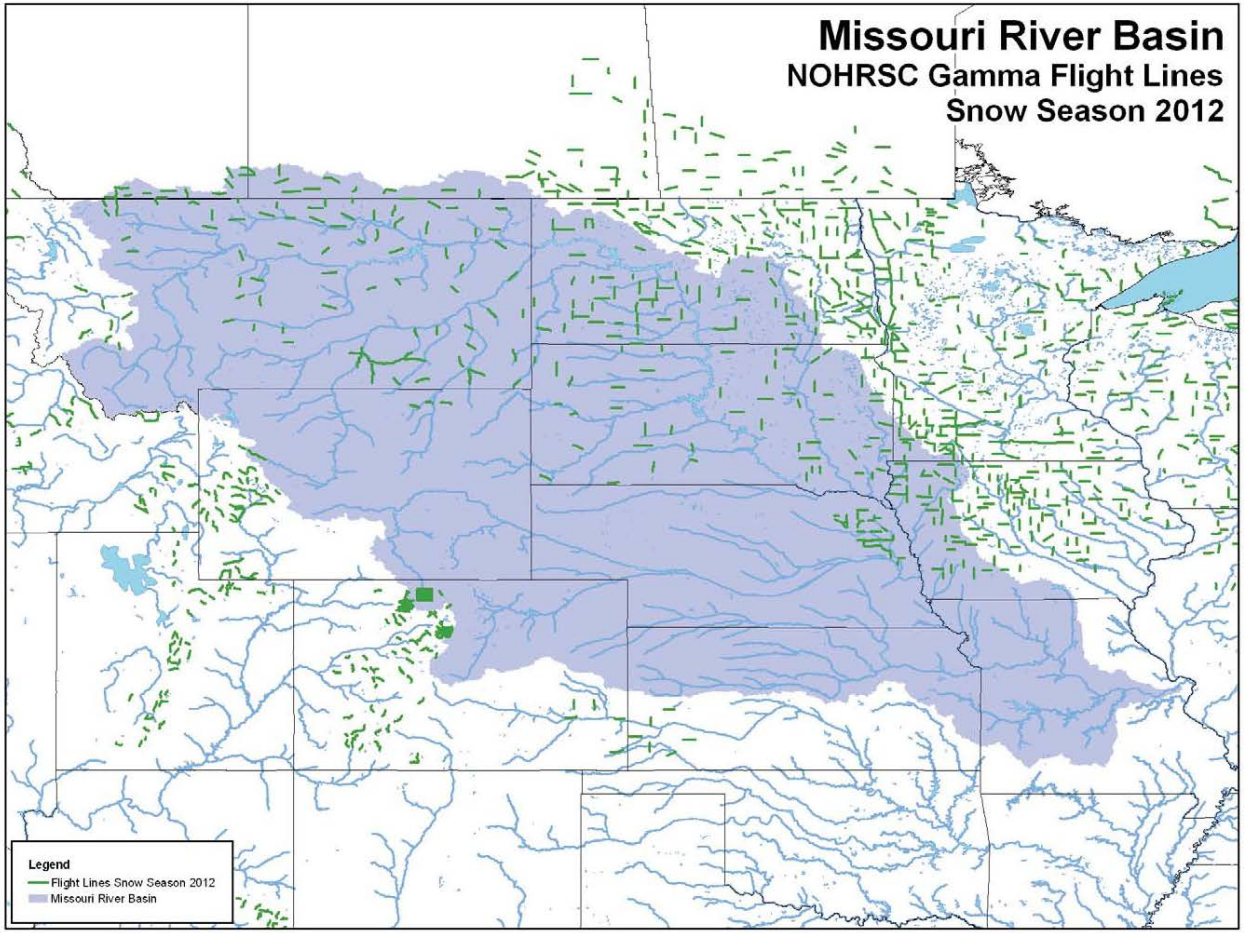
- **Gap Assessment** in monitoring, geographic areas and data acquired … what is missing?

- **Monitoring Recommendations** to identify what will be needed to meet short-term and long-term forecasting and monitoring goals.

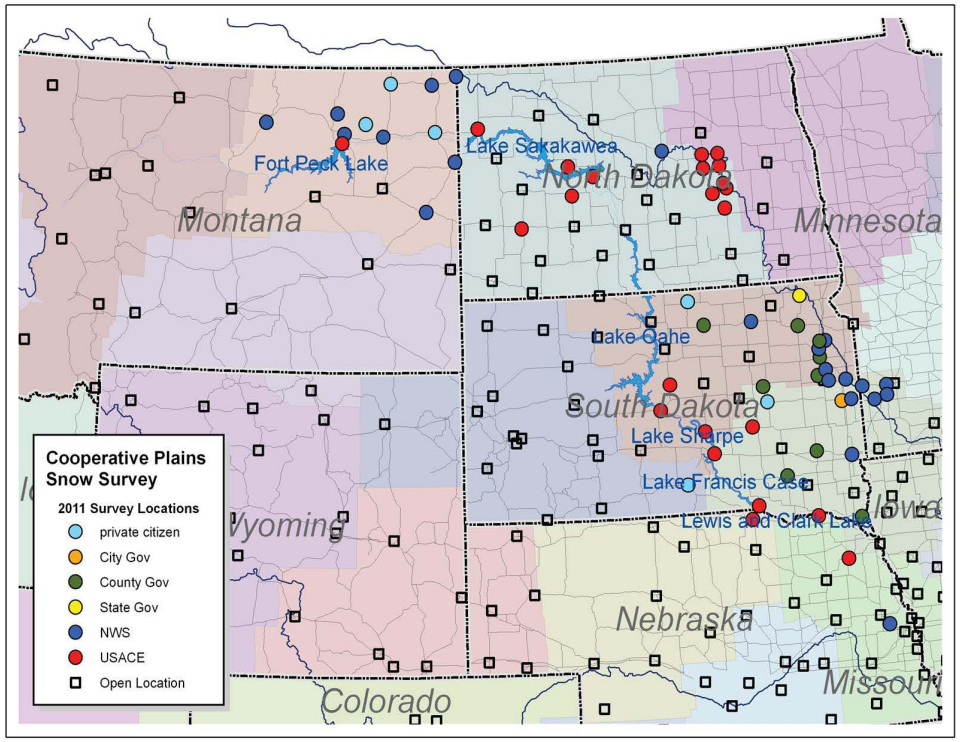



# Automated Measurements

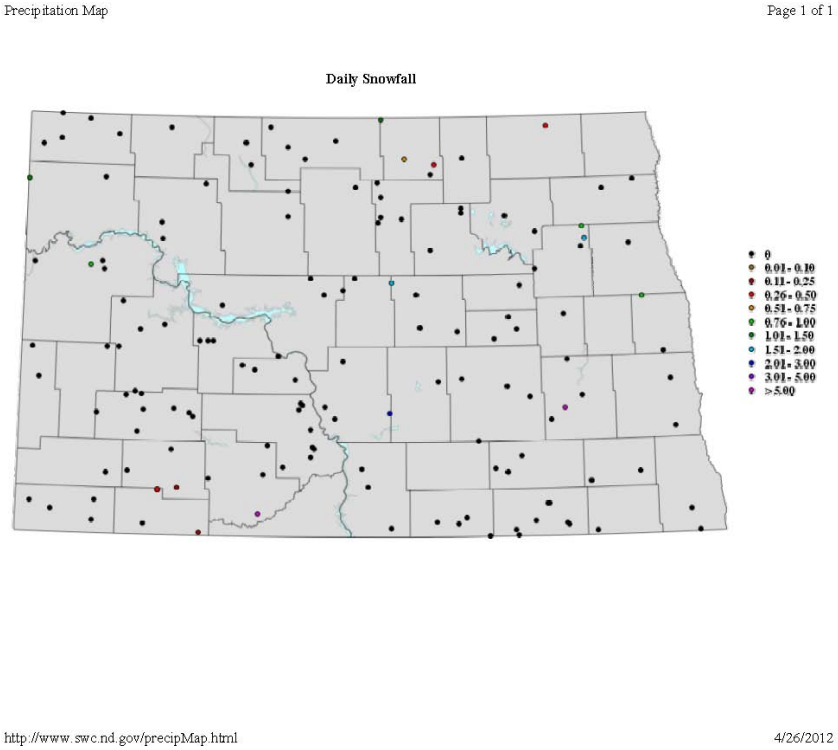
# Aerial Snow Surveys



# Manual Snow Sampling



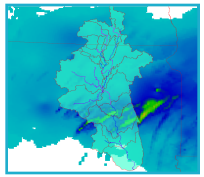

USACE



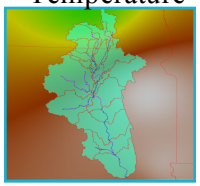

State of ND

# USACE Spring Snowmelt/Rainfall Runoff Modeling – End State

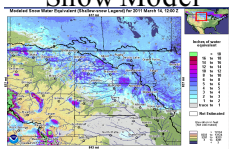
NWS MBRFC Precipitation



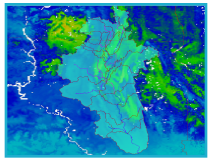
NWS/USACE Temperature



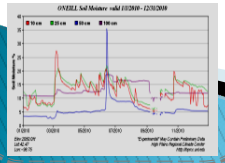
NWS NOHRSC Snow Model



USACE CRREL Snow Grid



NWS/NRCS/ State/USACE Soil Moisture



Observed Precipitation

Forecast Precipitation

Observed Temperature

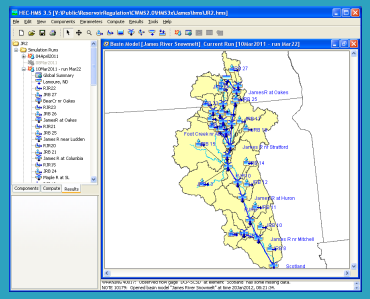
Forecast Temperature

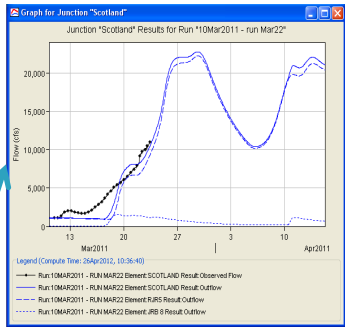
Current Snow Water Equivalent

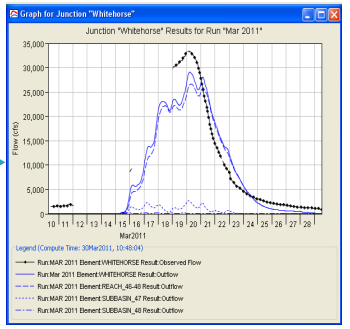
Current Soil Moisture

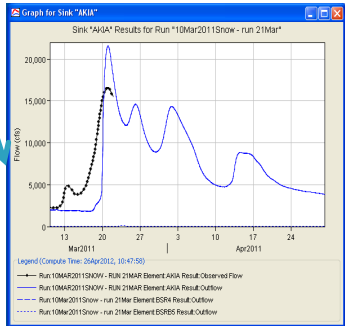
10 cm
25 cm
50 cm
100 cm

USACE HEC-HMS Snowmelt Runoff Models






Discussions on-going with HEC and CRREL regarding development of soil moisture grids and integration into HMS.

# Multiple Linear Regression

So, if we know …

- Plains snow depth
- Plains snow SWE
- Freezing/melting days (observed and forecast)
- Precipitation (observed and forecast)
- Antecedent flows (observed and forecast)
- Frost depth
- Soil moisture at various levels

Can we more accurately forecast …

- March and April runoff

(i) of y on x is $b_{yx} = \dfrac{r\sigma_y}{\sigma_x} = \dfrac{\operatorname{cov}(x,y)}{\sigma_x^2}$

(ii) of x on y is $b_{xy} = \dfrac{r\sigma_x}{\sigma_y} = \dfrac{\operatorname{cov}(x,y)}{\sigma_y^2}$

# Long-Term Investment

- Better understanding of basin … during flood, normal and drought conditions
- Consistency throughout the basin regarding instrumentation, standards, QA/QC
- Data collected real-time, quality controlled, archived and available to everyone

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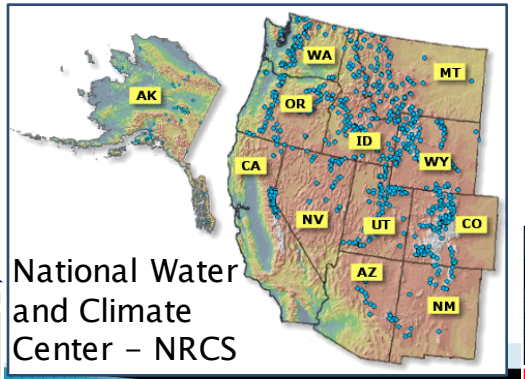


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